RESEARCH HIGHLIGHTS

October 2003 Technical Series 03-122

THE IMPACT OF REQUIRING HVAC SYSTEM DESIGN SUBMITTAL ON SYSTEM PERFORMANCE

Introduction

Recent CMHC research has shown that heating and ventilating components (HVAC) in new Canadian houses do not perform as intended, and that the fault is shared through bad design, inappropriate equipment selection, mediocre installation, and indifferent inspection. See the CMHC Research Highlights 00-106 and 02-118 on ventilation system testing. There are different levels of municipal involvement in the design and inspection procedures of residential HVAC installations. If a municipal authority required a significant HVAC design effort to obtain a permit, would this result in houses having better operating HVAC systems? This small research project attempted to answer this question.

Research Program

Two contrasting Alberta cities were selected. City A, at the permit stage, required heat loss calculations, appliance selection, and duct sizing to be submitted prior to permit approval. City B only required that the heating contractor employ a "Master" Sheet Metal Mechanic with at least three years of experience. Therefore, City A had far more stringent design requirements. The level of inspection differed as well, but in the opposite direction. City A did not require its inspectors to be experienced in HVAC systems, while those of City B had to have an HVAC background. Furnace sizing in City A had to match the plans. City B inspectors did a thorough rough-in inspection. Both city inspectors looked at return air locations and outdoor air intakes.

There were eight single family homes inspected in the project, five in City A and three in City B, by eight different builders. All had medium-efficiency furnaces in the basement and all had been occupied for at least one year. There were a variety of ventilation systems installed and the furnace circulating air system was always part of the ventilation system design. For each of the test houses, the researcher:

1. Calculated the house design heat loss using the HRAI Residential Heating and Cooling Load Calculation Manual
2. Compared the output capacity of the installed furnace to the calculated design heat loss
3. Measured the temperature rise of the installed furnace and compared this to the manufacturer's design temperature rise for the furnace
4. Measured airflow to and from all rooms to determine proportional air flow distribution
5. Measured ventilation airflows and compared them to National Building Code requirements for the house
6. Recorded the size of ducts installed
7. Interviewed occupants regarding their perception of comfort, noise and indoor air quality in their houses

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Results

The quality of the systems in City A and City B were not significantly different, perhaps in part to this being a small sample. See Table 1.

Table 1: Comparison of installed HVAC systems between City A and B

Houses	Furnace sizing (installed output/design heat loss) (%)	Supply air flows (actual/design) (%)	Ventilation meets NBC principal exhaust flow?	Homeowner comments
City A				
House 1	107	75	No	Satisfied
House 2	136	69	Yes	One cool room
House 3	118	72	No	One cool room
House 4	140	54	Yes	Satisfied
House 5	129	75	Yes	Satisfied
City B				
House 1	122	53	Yes	One cool room
House 2	114	31	No	Satisfied
House 3	163	48	Yes	Satisfied

The furnace sizing was surprisingly accurate, generally falling within the 100-140% sizing guideline of the CSA F280 heat loss standard. Other recent furnace research (see Highlight # 03-109) showed that furnace oversizing was more prevalent in a Saskatchewan sample of houses.

The systems in City A were marginally better, on average, than those of City B, but this study is at best a pilot comparison. A larger sample is required to quantify the differences in observed quality. Some of the reasons for the lack of difference might be:

1. There was no standardized form in City A for making the submission.
2. Documents submitted to City A were often incomplete, but still accepted by officials
3. The review and inspection of the submitted design in City A was not necessarily undertaken by a qualified tradesperson. The inspectors in City B had to have HVAC qualifications.
4. Enforcement is lax. On-site inspection in either city missed many problems or deficiencies, or did not require the builders to adhere to the code (as shown in the table above).

Implications for the Building Industry

The study did not conclusively show that more stringent design submissions, at the municipal permit stage, result in better HVAC installations in houses. The small house sample contributed to this uncertainty. As well, the permit requirements in City A have only recently been imposed, and it may take some time for the benefits to be realised. The field testing echoed earlier studies in showing that current HVAC installations do not meet code, and that municipal inspections do not identify the deficiencies or call for rectification. However, despite these apparent shortcomings, homeowners were generally satisfied with the installed systems.

2007-00547

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